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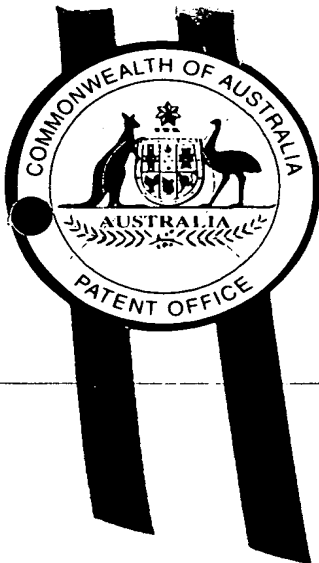
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I, LEANNE MYNOTT, TEAM LEADER EXAMINATION SUPPORT AND SALES hereby certify that annexed is a true copy of the Provisional specification in connection with Application No. PQ 2466 for a patent by REAL GUARDIAN PTY LTD filed on 26 August 1999.



WITNESS my hand this  
Eighth day of October 1999

LEANNE MYNOTT  
TEAM LEADER EXAMINATION  
SUPPORT AND SALES

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**PROVISIONAL SPECIFICATION**

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***FOR THE INVENTION ENTITLED:-***

**"AN APPARATUS FOR PROVIDING AN INDICATION OF A TIME INTERVAL"**

The invention is described in the following statement:-

The present invention relates to an apparatus for providing an indication of a time interval and in particular to an apparatus for providing an indication of a time interval between a first group of people which is progressing about a course and a second group of people which is following the first group.

5       The invention has been developed primarily for use at golf courses, and will predominantly be described hereinafter with reference to that application. However, it will be appreciated that the invention is not limited to this particular field of use.

A common problem experienced when groups of people follow each other around a set course, for example at golf courses, is that some groups may be regarded by other  
10   groups, and by the course management, as progressing too slowly. Various means of encouraging, and in some cases forcing, slow groups to speed up have been contemplated. However, these methods are frustrated by a fairly common belief among members of a slow group that they are not responsible for the slow progress as they are being held up by the group in front of them.

15       It is an object of the present invention to overcome or ameliorate at least one of the disadvantages of the prior art, or to provide a useful alternative.

According to a first aspect of the invention there is provided an apparatus for providing an indication of a time interval between a first group of people which is  
progressing about a course and a second group of people which is following the first group,  
20   the apparatus including:

an actuation means for providing respective actuating signals indicative of the presence of the first and the second group at a predetermined location on the course;

a calculation means being responsive to the actuating signals for providing a time signal indicative of the time interval between the actuating signals; and

display means for providing the second group with an indication of the time interval.

Preferably, the groups include one or more golfers and the course is a golf course.

- 5 More preferably, the actuation means is located at the predetermined location and the display means is disposed at or adjacent to the location for displaying information indicative of the time interval when the second group is proximal to the display means. Even more preferably, the apparatus includes a plurality of actuation means which are disposed at respective predetermined locations spaced apart on the golf course. Still more preferably,
- 10 the locations are passed by the groups during the normal course of play.

Preferably also, each location is at one of a respective: tee; green; fairway; between a green and a tee; or on a pathway traversed by the groups during the normal course of play.

- In a preferred form the indication of the time interval provided by the display means includes an indication as to whether the time interval is within a predetermined acceptable
- 15 range. Alternatively, or additionally, the indication of the time interval provided by the display means includes a quantification of the time interval.

Preferably, the display means is fixedly disposed at or adjacent to the location. In other embodiments, however, the display means is movable and carried by or moves with

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the second group.

- 20 Preferably also, the apparatus includes a locating device for determining the position of the second group and the time elapsed since the first group was at that position. More preferably, the locating device is a GPS unit.

In a preferred form, the actuation means includes both an input device for providing actuating signals upon the arrivals of the groups at the location and a timer which is responsive to the signals for determining the time interval between the groups' arrivals. More preferably, each group is comprised of one or more members and the input device  
5 includes a button operable by one of those members. In other embodiments, the input device automatically senses the presence of each group. In this case, the input device is preferably selected from one or more of the following: a force sensor such as a pressure pad or vibration sensor; an electromagnetic wave sensor; and an ultrasonic transducer.

Preferably also, the apparatus includes a central unit wherein the actuating units have  
10 communication means for allowing the transmission to the central unit of information indicative of either the time interval or the actuating signal.

Preferably, the groups include respective identification devices and the input devices are responsive to the identification devices for providing the respective actuating signals. More preferably, the identification devices contain data in an electronic or magnetic form  
15 and the input devices include a respective electronic or magnetic reader for reading the data. More preferably, the identification devices are selected from the following: magnetic keys; SMART cards; swipe cards; or radio transponders. Preferably, in embodiments where the identification devices are transponders, those transponders are mounted to respective golf  

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carts. More preferably, the display means are also mounted to respective carts.

20 In a preferred form the identification device also functions as an electronic score card.

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Preferably, the identification device is a hand held radio transmitter which includes a keypad for the golfers in the respective group to enter their scores for the hole just completed. More preferably, the data, once entered, is transmitted to a central processing site. Even more preferably, the timing of the transmission is used by the actuation means to  
5 effect generation of the actuating signal.

Preferably also, the calculation means and the display means are located adjacent to the location. In other embodiments, however, the calculation means and the display means are collectively packaged and are carried by or move with the second group.

In a preferred form, one person in the respective groups, upon reaching an actuation  
10 means, enters a previously allocated unique identifying number before an actuating signal will be generated.

Preferably, the actuation means, the calculation means and the display means are contained within a single housing. More preferably, the housing is movable and is carried by or moves with the second group as they progress. Even more preferably, the apparatus  
15 includes a GPS unit for providing positioning information and for actuating the actuating means when the group is at or adjacent to the predetermined location.

Preferably also, the first group is following a third group around the course and the display means provides an indication of the time interval between the third group and the  
first group arriving at the location.

20 According to a second aspect of the invention there is provided an apparatus for monitoring a first group of people and a second group of people, the apparatus including:  
a central unit;

a plurality of actuating means being disposed at respective spaced apart locations remote from the central unit for providing both respective first signals in response to the first group of people being at or proximal to the respective locations and respective second signals in response to the second group of people being at or proximal to the respective  
5 locations;

calculation means being responsive to the respective first and second signals for generating a third signal indicative of the time interval between the groups being at or proximal to the respective locations;

communication means for allowing transmission of one or more of the first, second  
10 and third signals between the central unit and one or more of the actuation means;

display means being responsive to the third signal for displaying information indicative of the time interval.

Preferably, each actuation means includes an alarm and the central unit is responsive to the third signal for determining whether the time interval falls above a predetermined  
15 threshold and, if so, communicates a fourth signal to the respective actuation means to actuate the alarm. Preferably also, the alarm is audible. More preferably, the alarm is visual. Even more preferably, the alarm is both audible and visual.

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In a preferred form, the calculation means includes a plurality of separate timing  
devices located at respective actuation means. In other embodiments use is made of a single  
20 timer device. Preferably, the single device is located at the central unit. However, in some embodiments, the single device is located at one of the actuation means.

Preferably also, the display means includes a plurality of displays located at or adjacent to respective actuation means to allow the group proximal to that actuation means to view the information indicative of the time interval. More preferably, the display means includes a display at or adjacent to the central unit. Even more preferably, the central unit is  
5 an actuating means.

According to another aspect of the invention there is provided a method for establishing playing patterns of groups of golfers as they proceed around a golf course, the method including the steps of:

- (a) providing a plurality of actuating means at points on the golf course which  
10 are passed by the groups in the normal course of play, each of the actuating means including both sensing means to automatically sense the passing or close proximity of groups of golfers and timing means responsive to the sensing means;
- (b) allowing the groups to progress around the course such that the actuating means automatically record time intervals between successive groups of golfers;
- 15 (c) as a particular group completes the course, calculating the time interval for the particular group with reference to a group immediately preceding the particular group under consideration; and
- (d) determining a playing pattern of the particular group based upon the time  
intervals.

20 As used in the present document, a person proceeding around a course on his or her own falls within the scope of terms like "group of people" or "group of golfers".

Additionally, it is to be understood that a golf course includes a number of holes which are



sequentially played by the golfers. Each hole includes a tee and a green, with the green of one hole being generally adjacent to the tee of the following hole. Most holes include a fairway extending between the tee and the green.

Preferred embodiments of the invention will now be described, by way of example  
5 only, with reference to the accompanying drawings, in which:

Figure 1 is a diagrammatic plan view of a portion of a golf course incorporating a system according to a first aspect of the invention;

Figure 2 is a front view of the display face of the system of Figure 1;

Figure 3 is a perspective view of an alternative metering unit which is mounted next  
10 to a path which golfers follow on the course;

Figure 4 is a perspective view of another metering unit;

Figure 5 is a front view of a display face of the metering unit of Figure 4;

Figure 6 is a side elevation of another metering unit;

Figure 7 is a front elevation of the metering unit of Figure 6;

15 Figure 8 is a front view of a display face of the unit of Figure 7;

Figure 9 is a schematic diagram of the control circuitry for the unit of Figure 4; and

Figure 10 is a schematic depiction of a preferred system in accordance with the third  
aspect of the invention.

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Referring to Figure 1, there is illustrated a system 1 for recording a time interval  
20 between a first group of golfers and a second group of golfers. System 1 includes two spaced apart metering units 2 and 3 located adjacent to tees 4 and 5 on successive holes of a golf course 6. Units 2 and 3 are responsive to the groups of golfers so as to determine the

time interval between the groups arriving at or being located proximal to the respective tees. As best shown in Figure 2, display means, in the form of a display face 7, is mounted to respective units 2 and 3 for responding to the respective units to display information indicative of the time interval between the groups.

5           System 1 determines and records the time interval between the first group of people and a second group of people as they proceed around course 6. In other embodiments the group is involved in an activity other than golf.

          While in this embodiment units 2 and 3 are disposed adjacent to respective tees 4 and 5, in other embodiments differing locations are utilised. Preferably, however, the  
10   locations are those that are likely to be passed only once by the groups of golfers in a normal round of golf at the particular course.

          Each of units 2 and 3 is activated by one or more of the golfers in the group to record the time interval between the respective groups at each of the given locations. Units 2 and 3 are preferably locally powered electronic devices. In this embodiment use is made of a  
15   rechargeable battery in combination with a solar collector (not shown). In other embodiments the units are connected to a mains power supply.

          Unit 3 includes an input mechanism in the form of a manually actuated button 12 which is disposed prominently and substantially centrally on face 7. The button is  

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depressed by a member of each group of golfers to indicate that the group has progressed to  
20   that particular location on the golf course. In other words, as a group of golfers comes across unit 3, a member of the group manually depresses button 12 to trigger unit 3 to calculate the time interval between the current group and the immediately preceding group.

Unit 3 simultaneously commences the measurement of a new timing interval between the current group and the following group.

In an alternative embodiment, unit 3 includes a timer which is sampled upon successive depression of button 12. The time interval is determined by a subtraction  
5 operation performed on the samples.

As best shown in Figure 2, face 7 is substantially rectangular and includes a linear array of spaced apart windows 16, 17, 18 and 19 for visually displaying the respective timed intervals between the last five successive groups. In this embodiment the intervals are expressed in minutes and seconds. In other embodiments, however, the intervals are  
10 expressed as being either within or outside an acceptable range. For example, if a group has unacceptably fallen behind an immediately preceding group, a red light is actuated to illuminate window 16. Alternatively, if the interval is sufficiently short then a green light illuminates window 16.

Although units 2 and 3 are illustrated as being included on two successive holes of  
15 course 6, in other embodiments they are located on two non-successive holes. Moreover, in further embodiments, like actuation units are disposed on other holes to provide the groups with more frequent information on their progress with respect to preceding groups.

In another embodiment (not illustrated) the display means are mounted to respective  
golf carts. That is, as the carts move into the proximity of one of the metering units, that  
20 unit provides a signal to actuate the display means to provide the necessary indication to the group of the time interval and whether that interval is within an acceptable range.

The use of system 1 raises the awareness of the golfers in the groups as to their speed of play relative to the speed of play of other groups of golfers using course 6. This, in turn, encourages the golfers not to fall too far behind the preceding group, thereby alleviating, for following groups, some of the frustrations which result from slow play. Also, by providing  
5 an indication of the times between previous groups of golfers, it is intended firstly to counter the feeling among golfers that they are not responsible for the slow play since they are being held up by the golfers in front of them and, secondly, to counter the feeling among golfers that there is no evidence that they are in fact playing slowly. These same advantages are provided by the other embodiments of the invention described below.

10 In some embodiments units 2 and 3 include respective printers for providing a printed representation of face 7 including the intervals displayed through windows 16 to 19.

In an alternative embodiment, such as that illustrated in Figure 3, unit 3 is mounted to a hollow post 9 which is adjacent to a path 10. The path leads from one putting green to the following tee. The input mechanism, which takes the form of a pressure pad 15  
15 disposed immediately under path 10, automatically senses the presence of a group of people as they progress along the path. Pad 15 is linked to unit 3 by way of an electrical lead 20 which extends internally through post 9. In further embodiments the input mechanism is an electro-magnetic or other sensor. For example, an alternative actuation unit 21 is illustrated

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in Figure 4. More particularly, unit 21 includes an input mechanism in the form of an  
20 ultrasonic device 22 that detects the presence of one or more persons in the proximity of the unit. The periphery of the field examined by device 22 is approximated by broken lines 23

and 24. As would be appreciated by those skilled in the art, device 22 is tuned for sensitivity and range.

In the Figure 4 embodiment, the passage of one or more of the golfers in the group into the field of examination will provide a trigger to unit 21 to stop timing the gap from the preceding group and to start timing the gap to the subsequent group. To avoid a repeat triggering by a group that has already been detected, unit 21 is configured to allow a predetermined period to pass from a triggering before a subsequent triggering will be detected. This predetermined period, in some embodiments, is varied in accordance with one or more of the following:

- 10       the number of golfers using the course;
- the concentration of golfers using different parts of the course;
- the number of groups using the course;
- the number of people in a particular group; and
- other factors.

15       Unit 21 includes display means in the form of substantially planar display face 25. As shown in Figure 5, this face includes six generally rectangular transparent windows 31, 32, 33, 34, 35 and 36 which are aligned along their right most sides and which are adjacent to an edge of the face. Window 31 includes a larger area than the remainder of the windows

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for prominently displaying the time delay between the arrival of the proximal group and that

20   of the immediately preceding group. The remainder of the windows are of equal area and display the delay between the arrivals of the successively preceding groups. Also included on face 25 is a series of printed indicia respectively arranged adjacent to the windows for

providing the group with an indication as to the significance of the display in the windows. As shown, the windows allow one or more of the golfers in the group proximal to unit 21 to view a digital representation of the relevant time intervals.

Optionally, a printer (not illustrated) is linked to unit 21 to output a printed record of the time intervals between successive groups. Preferably, the course utilises a plurality of like units 21 on separate holes and, as such, at the end of a round the group will have a corresponding plurality of printed records. In this embodiment, and to encourage the groups to progress about the course at a sufficient rate, the course administrators offer an incentive for the return of the records which indicate the group was within a predetermined interval from the preceding group at all the measured points. In some cases the incentive is financial such as a cash back offer, while in other cases the incentive is in kind such as a reduction in the green fees for the next round played at that course or a discount for goods and or services purchased at the course or associated outlets. In other embodiments the course administrators provide a strong disincentive for not returning the printed records, or for returning the records which indicate a poor rate of progress with respect to the immediately preceding group. For example, such disincentives include a failure to return a monetary deposit paid by the group prior to play or, for repeat offenders, a barring of that group from play at the course.

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Figure 9 is a more detailed schematic representation of the various components within unit 21. In particular, the operation of the unit is centred around a microprocessor that is responsive to various inputs to provide the necessary outputs. The microprocessor includes a number of ports for allowing selective communication with other devices such as

remote like units or a central controller. The latter configuration will be expanded upon below with reference to Figure 10.

Another alternative actuation unit 40 is illustrated in Figures 6 and 7 where corresponding features are denoted by corresponding reference numerals. Particularly, unit  
5 40 includes a body 41 for containing the necessary electronic circuitry and an upwardly directed display face 42 which is fixedly mounted to body 41. As in the embodiments described above, face 42 includes an array of four spaced apart windows 43, 44, 45 and 46 for providing the golfers in the respective groups with an indication as to the time delay between the groups. In this embodiment, the windows are rectangular and provide a  
10 numeric display of the elapsed time between the arrivals of successive groups at unit 40. Each of windows 43, 44, 45 and 46 is flanked by adjacent outlines of a golfer with a golf bag. One of the outlines, numbered 47, represents the group present at or adjacent to unit 40. The remainder of the outlines, when viewed from the left to the right of face 42, are progressively smaller in size. In some embodiments outline 47 is a window which is  
15 selectively illuminated to attract the attention of golfers in the group to unit 40.

In some embodiments one or more of the outlines is a silhouette of the golfer and a golf bag.

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Face 42 also includes a window 48 disposed beneath the other windows. This  
window displays the recommended maximum time delay for the group present at unit 40. In  
20 other embodiments, however, the window displays the current time.

Unit 40 includes a tubular post 49 which extends between two ends 50 and 51. End 51 is fixed within the earth adjacent to the path of travel of the group of golfers, while end

50 supports body 41 at a fixed distance above the ground. Preferably, body 41 is disposed at or about waist height. As best shown in Figure 7, intermediate ends 50 and 51 is an array of apertures 53 and an adjacent planar reflector plate 54. Post 49 includes two interior channels separated by a common internal wall 52.

5       Unit 40 makes use of an ultrasonic beam to determine the presence or otherwise of the next group of golfers. The beam is directed from body 41 downwardly into one of the internal channels in post 49 toward plate 54. Once impinging plate 54 the beam is redirected through apertures 53 and away from post 49. Any reflected portion of the beam is then redirected by plate 54 and through the other of the internal channels back toward  
10   body 41 for subsequent processing. The use of two separate internal channels reduces coupling of the input and output signals and, as such, reduces the risk of false readings.

      An alternative system 60 is shown in Figure 10 for calculating a time interval between a first group of people and a second group of people. System 60 includes a central unit 61 which is capable of communication with a plurality of remote and spaced apart  
15   actuation units 62, 63, 64 and 65. It will be appreciated that the term "central" when used in relation to unit 61 does not necessarily indicate a geographical centre. Moreover, although four actuation units are shown, in other embodiments a greater or lesser number of such units are used.

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      Units 62, 63, 64 and 65 are responsive to the passing or close proximity of groups of  
20   people for starting and stopping a timer (not illustrated) to calculate the relevant time intervals between different groups of people. For example, if it is necessary for system 60 to calculate the time interval between a first and second group, the actuation units firstly



respectively determine the passing or close proximity of the first group and starts the timer. Then, when the passing or close proximity of the second group of people to that same unit is determined, the timer is stopped. This function is as described with reference to the preceding embodiments. Additionally, however, system 60 provides for communication  
5 between units 62, 63, 64 and 65 and unit 61. In alternative embodiments units 62, 63, 64 and 65 do not include separate timers but, rather, a single timer is included at unit 61. In this embodiment, unit 61 is responsive to the start and stop signals provided by the separate actuation units for determining the relevant delay between groups and communicating this to the respective actuation units for display.

10           System 60, as with the other embodiments, includes display means disposed at or near respective units 62, 63, 64 and 65. In some embodiments, however, the display means also allows a viewer at unit 61 to inspect the relevant time delays. The latter arrangement enables groups to proceed to unit 61 after completing the course to review the information indicative of the time intervals. It also allows the course management to track the progress  
15 of the various groups around the course and to take more active policing action if continued delays occur beyond what is deemed acceptable.

In some embodiments a printer (not illustrated) is linked either directly or remotely to either unit 61 or one or more of the units 62, 63, 64 and 65.

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The preferred method for establishing playing patterns of groups of golfers as they  
20 proceed around a golf course includes the steps of:

(a) providing a plurality of metering units at points on the golf course which are passed by the groups in the normal course of play, each of the units including sensing means

to automatically sense the passing or close proximity of groups of golfers, the units further including timing means (not illustrated) responsive to the sensing means;

(b) allowing the groups to progress around the course such that the metering units automatically record time intervals between successive groups of golfers;

5 (c) as a particular group completes the course, compiling the time interval for the particular group with reference to a group immediately preceding the particular group under consideration; and

(d) determining a playing pattern of the particular group based upon the time intervals. For example, the maintenance by a particular group of a fairly constant time  
10 interval from the immediately preceding group, would indicate that the group under consideration was proceeding around the course approximately as quickly as the immediately preceding group. Alternatively, a progressive increase in the intervals between the group under consideration and the immediately preceding group would indicate that the group under consideration was proceeding more slowly than the immediately preceding  
15 group.

As used in this document, terms such as "groups of people" or "groups of golfers" refer not only to a plurality of people, but also to individuals proceeding around a course on their own.

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In other embodiments of the invention each group carries an identification device  
20 and the metering units include input devices that are responsive to the identification devices for providing respective actuating signals. These actuation signal are used to determine the time interval between the arrival of the successive groups at the respective locations.

The identification devices contain data in an electronic or magnetic form and the input devices include respective electronic or magnetic readers for reading the data. For example, in some embodiments the identification devices are magnetic keys, while in other embodiments the identification devices are SMART cards. It will be appreciated that other means of data storage and retrieval are known and applicable in other embodiments. Again, by way of example, further embodiments utilise identification devices in the form of transponders.

For those golf courses where use is made of golf carts, it is preferred that the identification devices are mounted to respective carts.

10 A further embodiment requires that one person in the group, upon reaching a actuation unit, must enter a previously allocated unique identifying number before an actuating signal will be generated. This form of identification is used alone or in combination with other identification such as the SMART card, a swipe card or other readable devices discussed above.

15 Reference is now made to Figure 9 which illustrates a block diagram of a preferred actuation unit. The various features of this unit are outlined in the following description.

### **Microcontroller**

The microcontroller provides the main intelligence and processing capability of the unit. The major components of the microcontroller are:

- 20
- Type: Single chip 8 bit microcontroller with embedded peripherals.
  - Code Storage: At least 8 Kbytes of code storage space. OTP and mask programmable variants to be supported.

- RAM: At least 256 bytes of on-board RAM.
- A/D: At least 2 A/D inputs each of at least 8 bits resolution.
- I2C: I2C interface to be supported as a master, or synthesised in firmware.
- UART: UART to support bi-directional asynchronous interface.
- 5     • Timer/Counter: Timer/Counter with PWM or overflow output capable of generating 1 millisecond bursts of 40 kHz tone.
- I/O ports: At least 8 bi-directional I/O pins.
- Clock: Capable of operating from resonator or crystal clocks in the range 500 kHz to 10 MHz.
- 10    • Watchdog: Internal watchdog timer to be available.
- Power Supply: Capable of low current operation from power supplies down to 3 Vdc, with low current consumption standby modes available.
- Firmware: High level language support (preferably 'C').
- Emulation: Low cost or loan in-circuit emulation facilities to be available.
- 15    In other embodiments use is made of a microcontroller type or configuration different from the above.

### **User Display**

The user display provides the means by which the time gaps between successive  
groups of golfers are displayed. Six separate LCD displays are included, each providing  
20 four digits capable of displaying numeric values in 7-segment format. This allows the time  
to be displayed in MM:SS format. The display which presents the time interval from the  
first preceding group to the current group is larger than the other two displays, with a digit

height of 15 to 20 mm being desirable. The displays which presents the time gap for subsequent groups of golfers (and the target time gap) are smaller, with a digit height of 8 to 12 mm being desirable. Different display sizes and different numbers of displays are used in alternative embodiments. However, cost or power consumption penalties can arise.

- 5           The display provides adequate contrast and a wide viewing angle over the specified operating temperature range of the unit. In this case the operating temperature is -10 °C to +60 °C.

The display is driven by a multiplexing display driver device with direct segment and backplane drive capability.

- 10           A backlight option is used for use in continuously powered applications.

#### **User Display Driver**

- The user display driver provides the interface between the microcontroller and the user display. The user display driver drives five separate LCD displays. Each of these displays includes 4 seven-segment digits plus a colon, giving a total of 29 segments per  
15 display or 87 segments in total.

The interface between the user display driver and the microcontroller is via the I2C bus.

A range of suitable display driver devices is available, including microcontrollers  

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which provide this capability directly.

- 20           **Ultrasonic Transmitter and Driver**

The ultrasonic transmitter and driver generates bursts of ultrasonic energy of duration 0.1 to 10 milliseconds at a nominal frequency of 40 kHz and a repetition rate

between 1 and 10 bursts per second. The signal drive level is as high as possible with the available supply voltages.

Drive for the ultrasonic transmitter driver is directly from a microcontroller pin.

A range of ultrasonic transducer transmitter devices operating at various frequencies  
5 is available.

#### **Ultrasonic Receiver, Amplifier, Filter and Detector**

The ultrasonic receiver, filter, amplifier and detector receives bursts of ultrasonic energy of duration 0.1 to 10 milliseconds at a nominal frequency of 40 kHz and a repetition rate between 1 and 10 bursts per second. From this is produced a signal representative of  
10 the envelope of the burst for input to the microcontroller via an A/D input.

Amplification and bandpass filtering of the 40 kHz signal produced by the ultrasonic receiver is provided to maximise sensitivity. A threshold-free detection method is employed. Overall bandwidth allows detection of ultrasonic bursts of duration in the range 0.1 to 10 milliseconds. Receiver sensitivity is set as high as possible given the available  
15 supply voltages.

A range of ultrasonic transducer receiver devices operating at various frequencies is available.

#### **Battery Charging and Power Control**

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Battery charging and control facilities are provided to allow operation of the unit  
20 from power supplied by a solar panel, with lead-acid "Gel-Cell" battery as backup when insufficient power is available from the solar panel.

The battery charging configuration optimises the efficiency with which power from the solar panel is used to power the unit and/or recharge the battery, from maximum power in direct sunlight to minimal power in deep shade. Provision is made to ensure that the battery can not be over-charged.

- 5        The battery management configuration optimises the efficiency with which power from the battery is used to power the unit.

The microcontroller monitors the total amount of power available from the solar cell to enable the unit to be deactivated in conditions of full or near darkness.

- 10       The microcontroller monitors the amount of power being delivered from the solar cell to the battery, and the state of charge of the battery, to allow warning of battery depletion to be presented via the user display.

The power control facility allows power to be disconnected from idle sections of the unit, where this is required to minimise overall power consumption.

- 15       An auxiliary power connector is provided to allow powering of the unit from an external power source. The unit is protected from over-voltage, reverse polarity connections and transients on the auxiliary power connection. These measures include a high level of voltage isolation between the external power connection and the unit electronics.

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As indicated above, a range of powering configurations is practical and would be known to those skilled in the art.

## Serial Interface

The serial interface provides interfacing facilities for the microcontroller serial interface which is shared between external interfaces. This is effected by a multiplexer which is controlled by the microcontroller. The external interfaces which are supported are:

- 5       • RS-232 Interface which provides data signals TXD and RXD, plus handshake signals RTS and CTS. This is wired as DTE and fitted with a male DB9 connector. An RS-232 driver chip which incorporates static discharge protection is also employed.
- 10       • RS-485 Interface for use in networked deployments and which provides standard balanced RS-485 data signals. This interface employs an isolated driver which provides a high degree of voltage isolation between the RS-485 cabling and the microcontroller. Cabling connections to the driver provide transient protection and bypassing to ground. The RS-485 interface also employs an RJ12 connector supporting bi-polar data signals and communications earth. Additional pins on  
15       this connector allow for the connection of an external power supply to the unit.
- Infra-Red Interface for user control and data upload which provides a full duplex bi-directional serial interface conforming to IRDA standards at the physical and  
20       link level interfaces. The interface supports other operating modes including amplitude modulated carrier systems used for appliance remote control, and unmodulated baseband asynchronous serial communications.



Any other type of interface could be used, including a serial modem connection, power line signalling or any other suitable method exhibiting reasonable range performance and robustness.

The provision by the microcontroller of additional serial interfaces would avoid the  
5 requirement to use a multiplexer to share a single interface amongst multiple communications methods.

Auxiliary signals are connected between the receive data lines of each interface and the microcontroller to allow the microcontroller to detect activity on each interface when that interface is not selected as the microcontroller UART receive signal.

#### 10        **Microcontroller Oscillator**

The microcontroller oscillator provides the master clock signal to the microcontroller. Use is made of a ceramic resonator or quartz crystal device, operating in the range 500 kHz to 10 MHz, in conjunction with the microcontroller internal oscillator circuit.

#### 15        **Microcontroller Watchdog**

The microcontroller includes a watchdog circuit which asserts microcontroller reset whenever the microcontroller supply voltage falls below an acceptable level. A toggled  
type watchdog is used, which asserts reset when the microcontroller fails to toggle the  
watchdog input for a prescribed period. This ensures that the microcontroller is reset in the  
20 event of loss of program control.

### **Real Time Clock**

A real time clock interfaces with the microcontroller via the I2C bus. The real-time clock derives timing from its own crystal, and includes local battery backup capability to provide power in the event of disconnection of main unit power. For example, such a  
5 disconnection can occur during battery replacement or battery depletion.

Other types of real-time clock could be used.

### **EEPROM**

EEPROM of a minimum 256 bytes capacity interfacing to the microcontroller via I2C bus is used. A fitting option providing higher storage capacity of up to 16 Kbytes or  
10 more is also provided.

Other types and capacity of EEPROM could be used.

### **User LED's**

At least two high intensity LED's, one red, one green, are used for visual indication to users.  
15 Other numbers and types of LED or other visual indicator are used in other embodiments.

### **Beeper**

A beeper for audible indication to users. Other types of audible indicator are used in  
alternative embodiments.

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### **Firmware considerations**

Some complexity results from the requirement to implement responsive ultrasonic detection and ranging, whilst minimising average current consumption. Overall power management requirements impose further complexity constraints.

5           Ultrasonic detection is achieved by transmitting a brief burst of ultrasonic energy for typically 1 millisecond and accumulating received ultrasonic energy as a function of time. As the return trip delay for ultrasonic transmissions is of the order of 30 cm per millisecond, a 1 millisecond transmit duration and corresponding detector bandwidth allows ranging resolution of the order of 30 cm. Accordingly, a 3 metre range requires the received signal  
10   to be monitored for the order of 10 milliseconds.

          In this embodiment the ultrasonic ranging system operates in two modes, namely Target Acquisition with a "ping" rate of about twice per second, and Target Confirmation with a "ping" rate of about 10 times per second. During Target Acquisition, a positive indication of the presence of a target will cause the unit to enter Target Confirmation for a  
15   period of about 1 second, with averaging being used to confirm the presence of a target.

          Once a target has been confirmed as present, the unit monitors for the departure of the target by pinging at typically once per second. After a "dead" period, which is set as the minimum expected interval between groups, the unit then awaits the arrival of the next  
20   target which shall be considered to be the following group of players. The minimum interval between groups is adjustable.

The ultrasonic ranging technique includes a long term threshold or signal floor adjustment regime to allow static objects within range to be ignored. The signal floor rises and falls with time and is adjustable.

Adjustable signal averaging and filtering provisions are included in firmware to  
5 allow the optimisation of detection reliability and responsiveness.

The described method of ultrasonic detection is suitable for the function but is not prescriptive. Other detection strategies and parameter settings are feasible.

All adjustable parameters are stored in EEPROM in a redundant fashion with checksum protection. Facilities are provided to allow setting of parameters via a dumb  
10 terminal connected to the unit's RS-232 interface, or via the RS-485 and/or infra-red interfaces if fitted.

Facilities are provided to allow the following functions to be implemented:

- By use of an infra-red transmitting key, the unit operator is able to set the target interval between player groups.
- 15 • By use of an infra-red transmitting key, the unit operator is able to cancel the detection of his presence near the unit, to avoid disruption to player group interval determination.
- Storage of historical player group interval data, for display under control of the  
infra-red transmitting key.

20 These functions could be achieved by other means such as any of the interfaces provided, or a push button, or an internal reed switch and external magnet.

The hardware facilities provided by the unit allow many other facilities to be implemented, including but not limited to the following:

- Bi-directional communication via the infra-red interface with a device such as a PC, for the setting of operating parameters and uploading of historical player group interval records.
- Similar bi-directional communications via any of the cable-connected interfaces provided.
- Communication via cable or a radio link with a central control facility typically comprising a PC, for unit control and real-time monitoring of player group intervals and activity around the golf course.

In view of the design objective to minimise unit current consumption so as to allow solar powering, if the static current drain of any element when not in use is a significant factor in determining unit current consumption, provision is made to power down that element when not in use.

Although the invention has been described with reference to specific examples, it will be appreciated by those skilled in the art that the invention may be embodied in many other forms.

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THE CLAIMS DEFINING THE INVENTION ARE AS FOLLOWS:

1. An apparatus for providing an indication of a time interval between a first group of people which is progressing about a course and a second group of people which is following the first group, the apparatus including:
    - 5 an actuation means for providing respective actuating signals indicative of the presence of the first and the second group at a predetermined location on the course;  
a calculation means being responsive to the actuating signals for providing a timing signal indicative of the time interval between the actuating signals; and  
display means for providing the second group with an indication of the time interval.
  - 10 2. An apparatus according to claim 1 wherein the groups include one or more golfers and the course is a golf course.
  3. An apparatus according to claim 1 or claim 2 wherein the actuation means is located at the predetermined location and the display means is disposed at or adjacent to the location for displaying information indicative of the time interval when the second group is proximal  
15 to the display means.
  4. An apparatus according to claim 2 or claim 3 including a plurality of actuation means which are disposed at respective predetermined locations spaced apart on the golf course.
- 
5. An apparatus according to claim 4 wherein the locations are passed by the groups  
20 during the normal course of play.

6. An apparatus according to claim 5 wherein each location is at one of a respective:  
tee; green; fairway; between a green and a tee; or on a pathway traversed by the groups  
during the normal course of play.
7. An apparatus according to any one of the preceding claims wherein the indication of  
5 the time interval provided by the display means includes an indication as to whether the  
time interval is within a predetermined acceptable range.
8. An apparatus according to any one of the preceding claims wherein the indication of  
the time interval provided by the display means includes a quantification of the time  
interval.
- 10 9. An apparatus according to claim 1 wherein the display means is fixedly disposed at  
or adjacent to the location.
10. An apparatus according to claim 1 wherein the display means is movable and carried  
by or moves with the second group.
11. An apparatus according to claim 10 including a locating device for determining the  
15 position of the second group and the time elapsed since the first group was at that position.
12. An apparatus according to claim 11 wherein the locating device is a GPS unit.
13. An apparatus according to claim 1 wherein the actuation means includes both an  
input device for providing actuating signals upon the arrivals of the groups at the location
- 
- and a timer which is responsive to the signals for determining the time interval between the  
20 groups' arrivals.
14. An apparatus according to claim 13 wherein each group is comprised of one or more  
members and the input device includes a button operable by one of those members.

15. An apparatus according to claim 13 wherein the input device automatically senses the presence of each group.
16. An apparatus according to claim 15 wherein the input device is selected from one or more of the following: a force sensor such as a pressure pad or vibration sensor; an  
5 electromagnetic wave sensor; and an ultrasonic transducer.
17. An apparatus according to claim 4 including a central unit wherein the actuating units have communication means for allowing the transmission to the central unit of information indicative of either the time interval or the actuating signal.
18. An apparatus according to claim 13 wherein the groups include respective  
10 identification devices and the input devices are responsive to the identification devices for providing the respective actuating signals.
19. An apparatus according to claim 18 wherein the identification devices contain data in an electronic or magnetic form and the input devices include a respective electronic or magnetic reader for reading the data.
- 15 20. An apparatus according to claim 19 wherein the identification devices are selected from the following: magnetic keys; SMART cards; swipe cards; or radio transponders.
21. An apparatus according to claim 20 wherein the identification devices are transponders which are mounted to respective golf carts.
- 
22. An apparatus according to claim 21 wherein the display means are mounted to  
20 respective carts.
23. An apparatus according to claim 18 wherein the identification device also functions as an electronic score card.



24. An apparatus according to claim 23 wherein the identification device is a hand held radio transmitter which includes a keypad for the golfers in the respective group to enter their scores for the hole just completed.
25. An apparatus according to claim 24 wherein the data, once entered, is transmitted to  
5 a central processing site.
26. An apparatus according to claim 25 wherein the timing of the transmission is used by the actuation means to effect generation of the actuating signal.
27. An apparatus according to claim 1 wherein the calculation means and the display means are located adjacent to the location.
- 10 28. An apparatus according to claim 1 wherein the calculation means and the display means are collectively packaged and are carried by or move with the second group.
29. An apparatus according to claim 1 wherein one person in the respective groups, upon reaching an actuation means, enters a previously allocated unique identifying number before an actuating signal will be generated.
- 15 30. An apparatus according to claim 1 wherein the actuation means, the calculation means and the display means are contained within a single housing.
31. An apparatus according to claim 30 wherein the housing is movable and is carried by or follows the second group as they progress.
- 
32. An apparatus according to claim 31 including a GPS unit for providing positioning  
20 information and for actuating the actuating means when the group is at or adjacent to the predetermined location.

33. An apparatus according to claim 1 wherein the first group is following a third group around the course and the display means provides an indication of the time interval between the third group and the first group arriving at the location.

34. An apparatus for monitoring a first group of people and a second group of people,  
5 the apparatus including:
- a central unit;
  - a plurality of actuating means being disposed at respective spaced apart locations remote from the central unit for providing both respective first signals in response to the first group of people being at or proximal to the respective locations and respective second  
10 signals in response to the second group of people being at or proximal to the respective locations;
  - calculation means being responsive to the respective first and second signals for generating a third signal indicative of the time interval between the groups being at or proximal to the respective locations;
  - 15 communication means for allowing transmission of one or more of the first, second and third signals between the central unit and one or more of the actuation means;
  - display means being responsive to the third signal for displaying information indicative of the time interval.
- 

35. An apparatus according to claim 34 wherein each actuation means includes an alarm  
20 and the central unit is responsive to the third signal for determining whether the time interval falls above a predetermined threshold and, if so, communicates a fourth signal to the respective actuation means to actuate the alarm.

36. An apparatus according to claim 35 wherein the alarm is audible.
37. An apparatus according to claim 35 wherein the alarm is visual.
38. An apparatus according to claim 35 wherein the alarm is both audible and visual.
39. An apparatus according to claim 34 wherein the calculation means includes a  
5 plurality of separate timing devices located at respective actuation means.
40. An apparatus according to claim 34 wherein use is made of a single timer device.
41. An apparatus according to claim 40 wherein the single device is located at the  
central unit.
42. An apparatus according to claim 40 wherein the single device is located at one of the  
10 actuation means.
43. An apparatus according to any one of claims 34 to 42 wherein the display means  
includes a plurality of displays located at or adjacent to respective actuation means to allow  
the group proximal to that actuation means to view the information indicative of the time  
interval.
- 15 44. An apparatus according to any one of claims 34 to 43 wherein the display means  
includes a display at or adjacent to the central unit.
45. An apparatus according to any one of claims 34 to 44 wherein the central unit is an  
actuating means.
- 
46. A method for establishing playing patterns of groups of golfers as they proceed  
20 around a golf course, the method including the steps of:
- (a) providing a plurality of actuating means at points on the golf course which  
are passed by the groups in the normal course of play, each of the actuating means including

both sensing means to automatically sense the passing or close proximity of groups of golfers and timing means responsive to the sensing means;

(b) allowing the groups to progress around the course such that the actuating means automatically record time intervals between successive groups of golfers;

5 (c) as a particular group completes the course, calculating the time interval for the particular group with reference to a group immediately preceding the particular group under consideration; and

(d) determining a playing pattern of the particular group based upon the time intervals.

10 DATED this 26th day of August 1999  
REAL GUARDIAN PTY LTD

Attorney: JOHN B. REDFERN  
Fellow Institute of Patent Attorneys of Australia  
of BALDWIN SHELSTON WATERS

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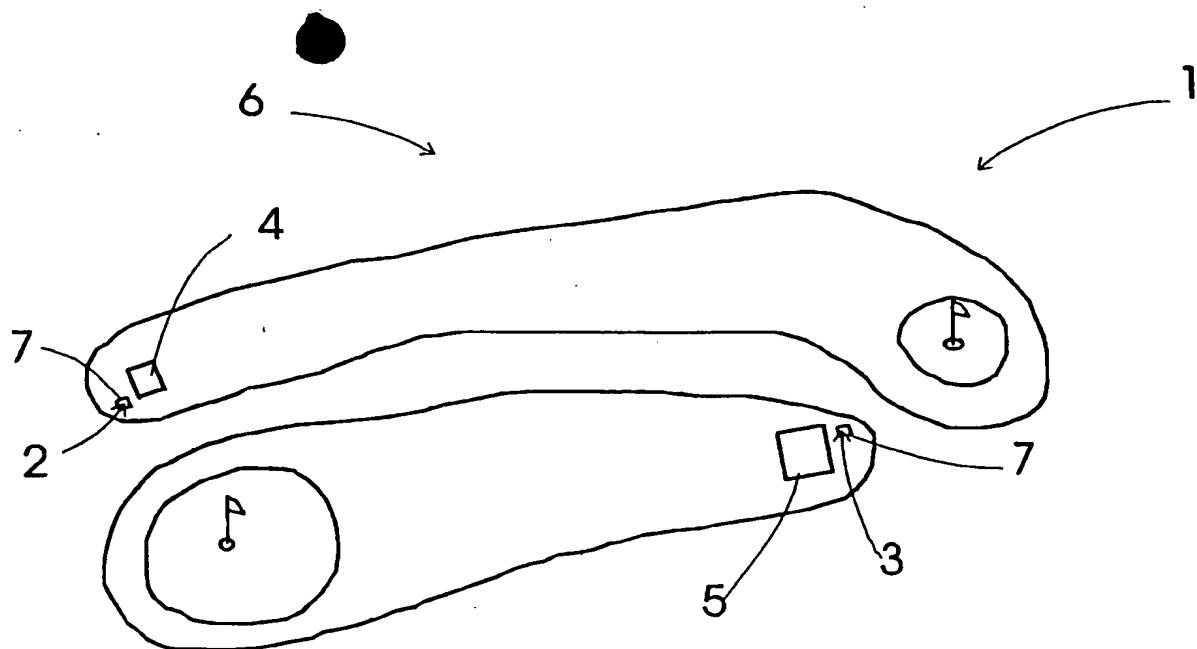


Figure 1

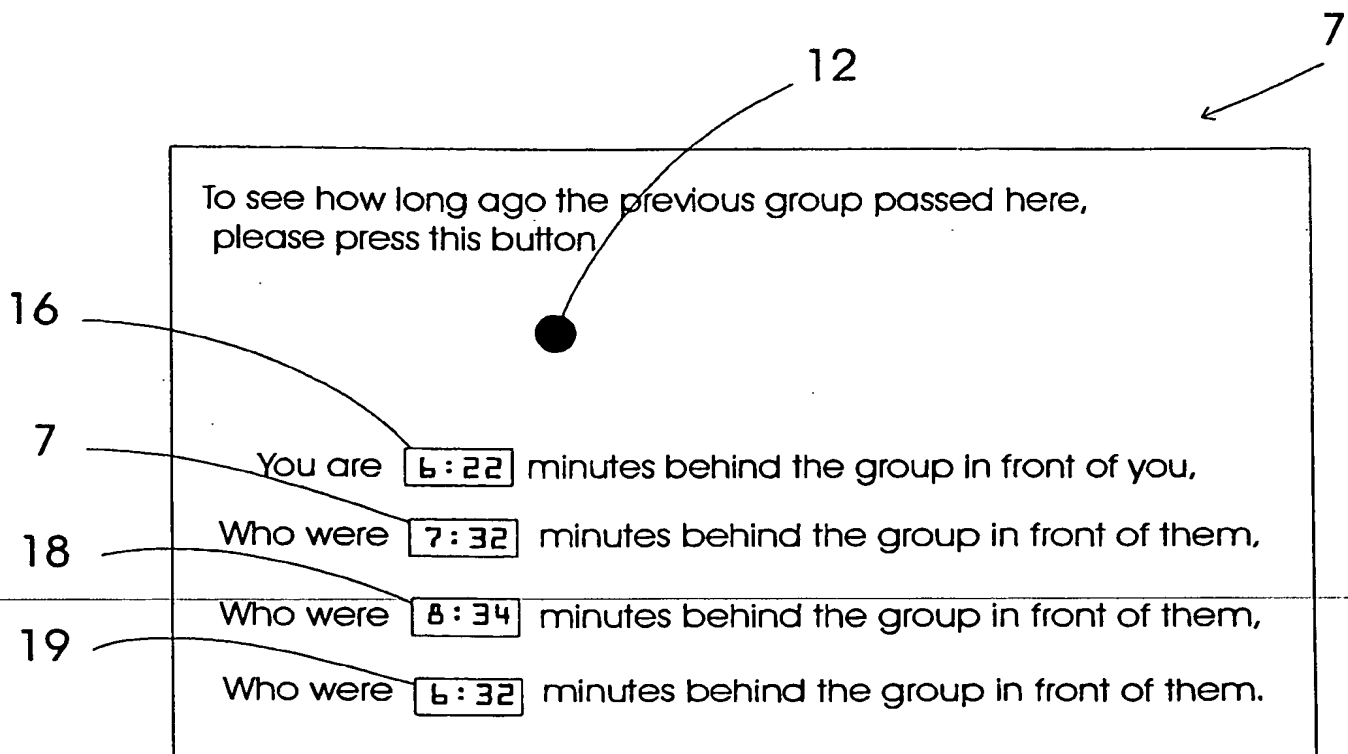


Figure 2

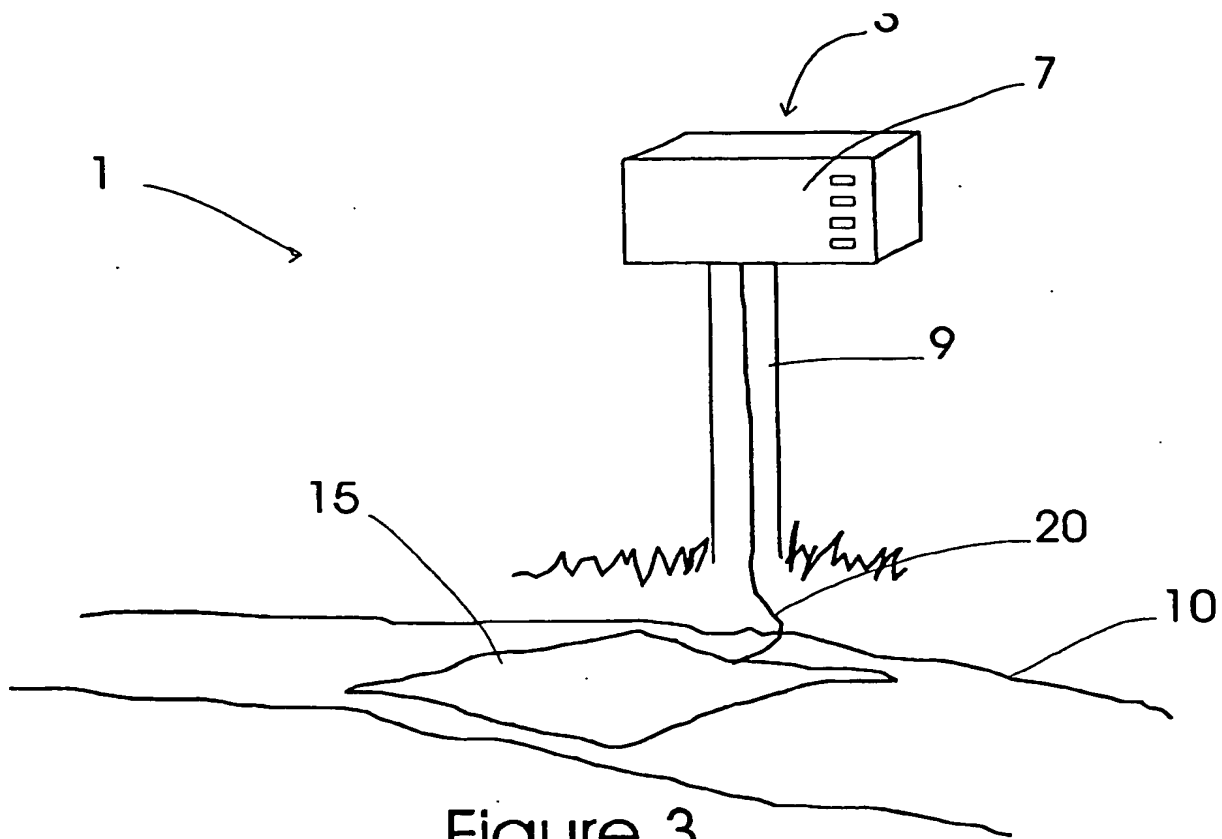


Figure 3

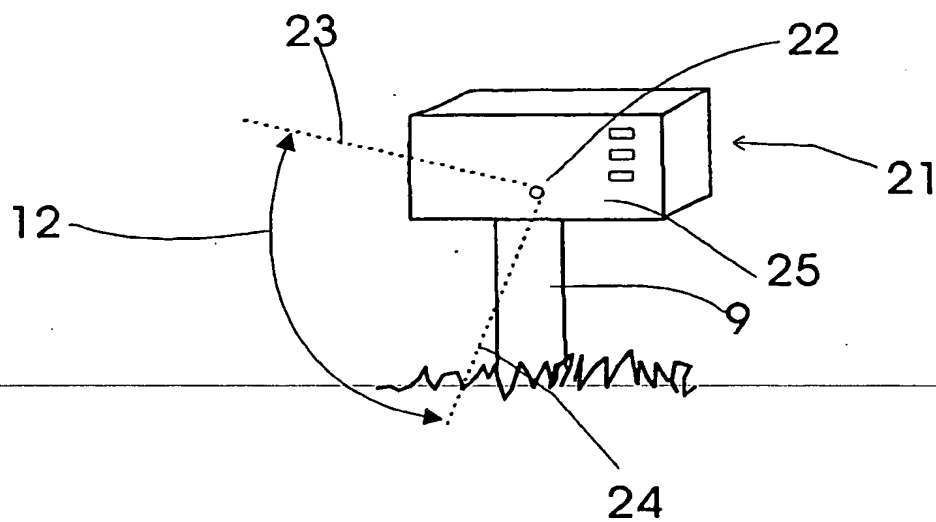


Figure 4

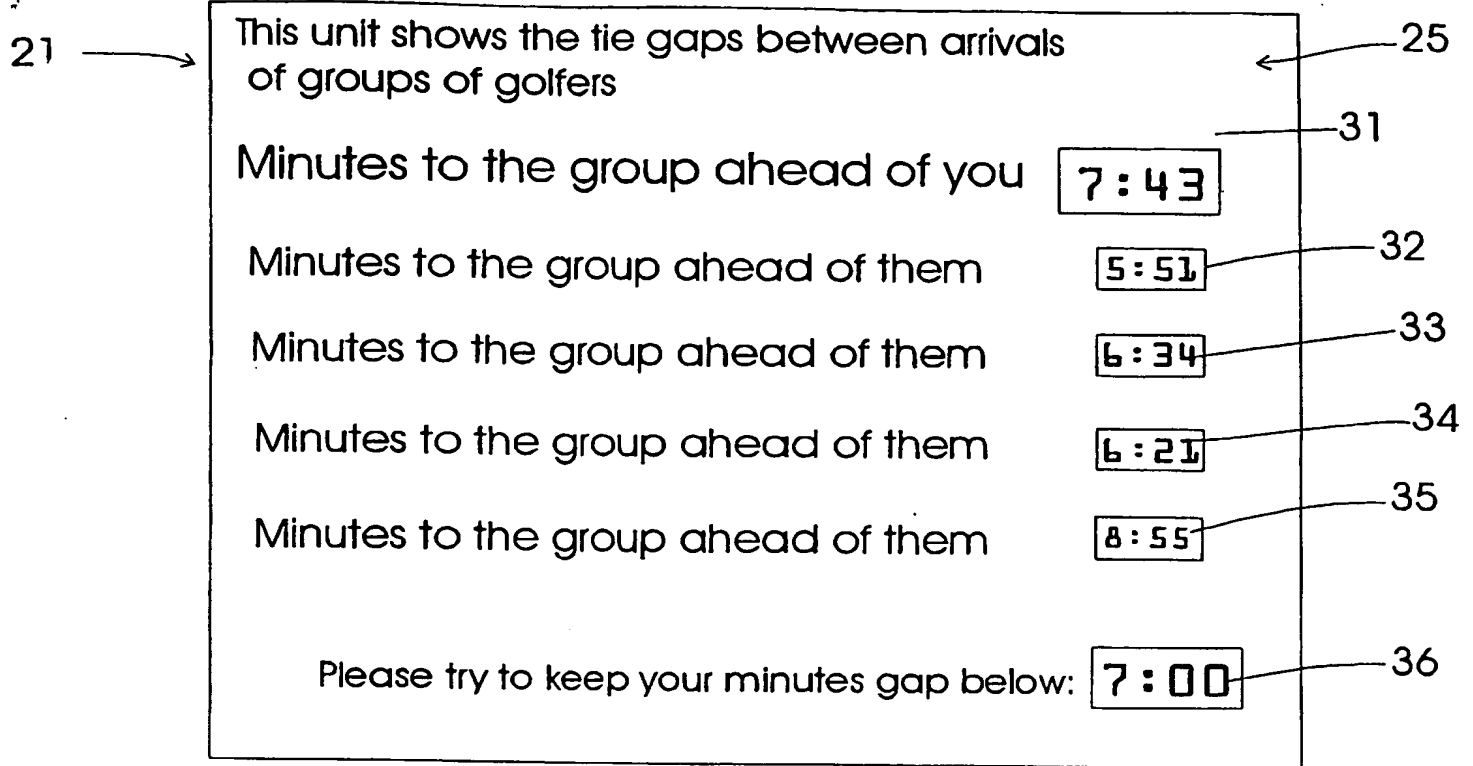


Figure 5

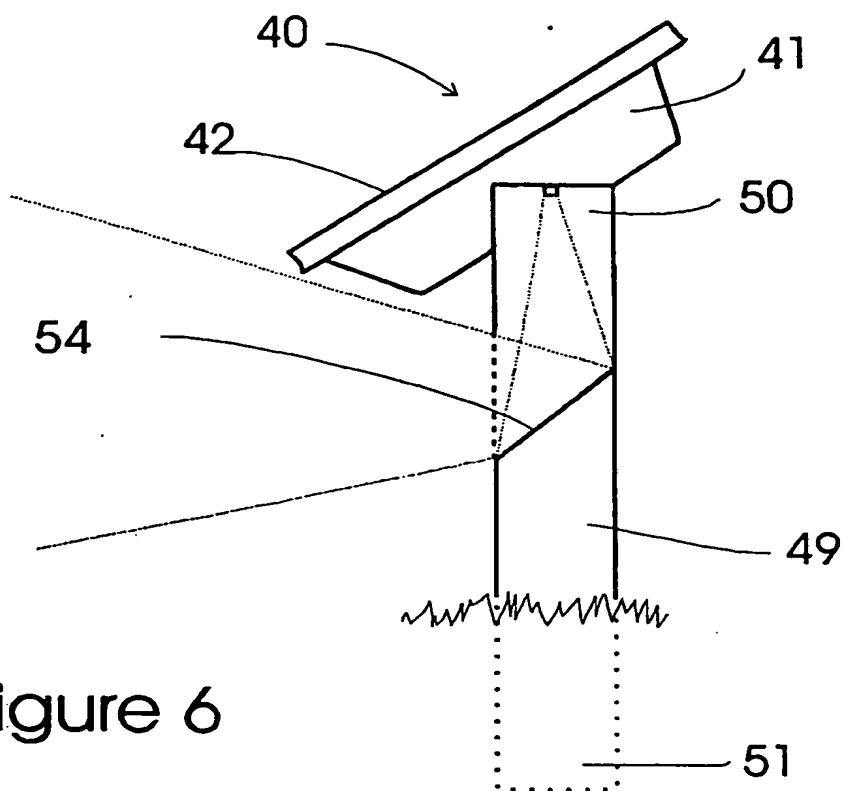


Figure 6

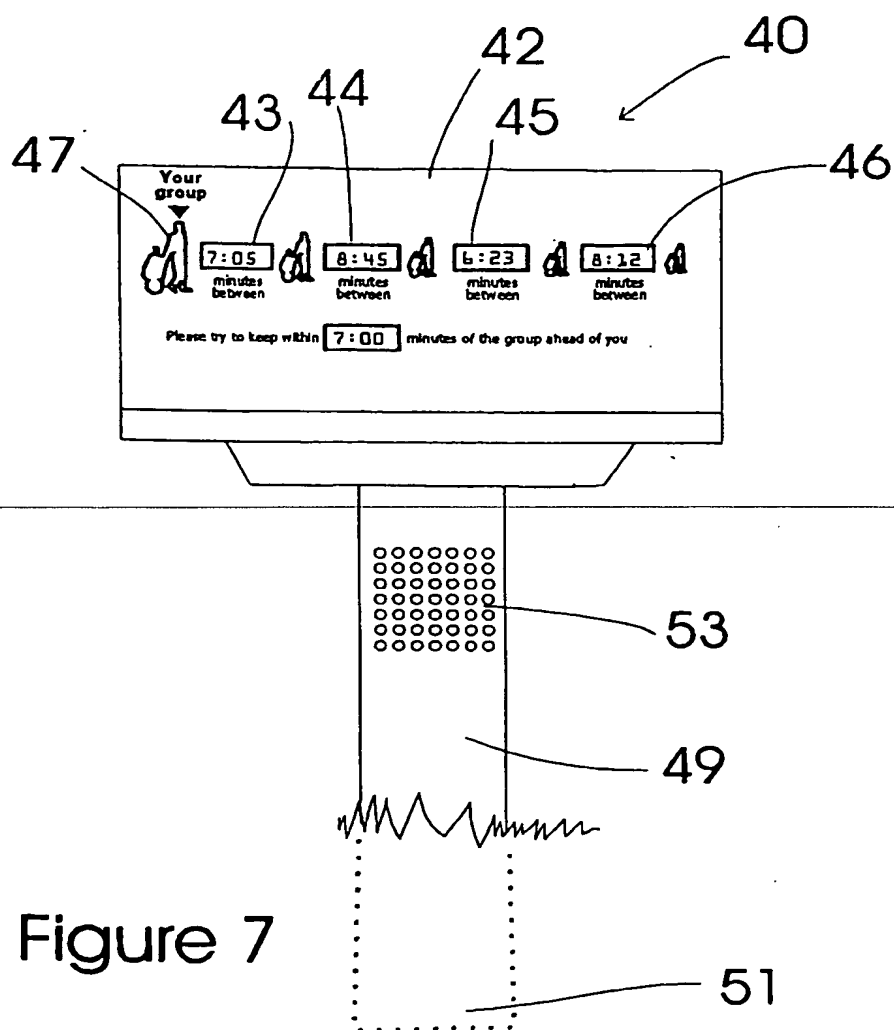


Figure 7



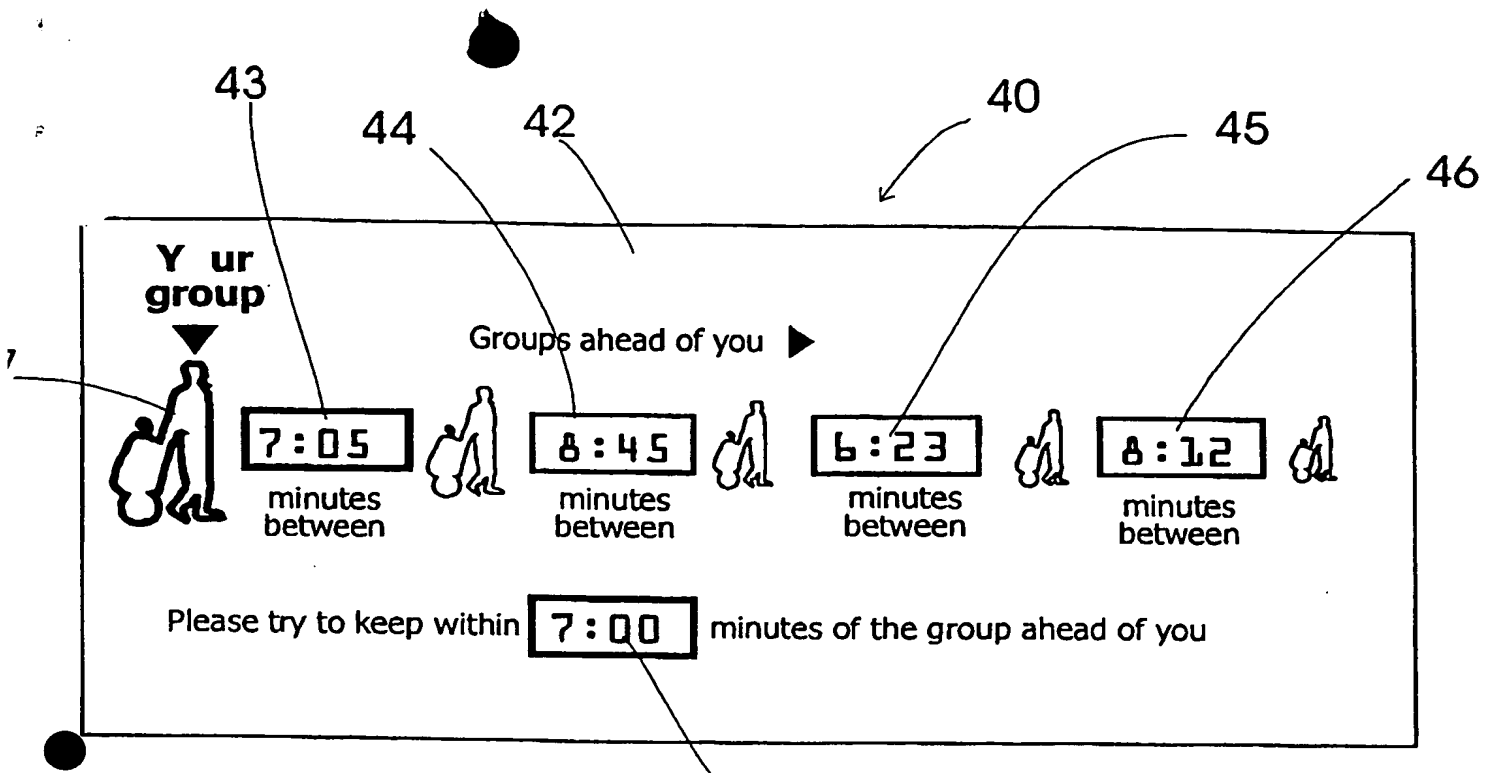


Figure 8

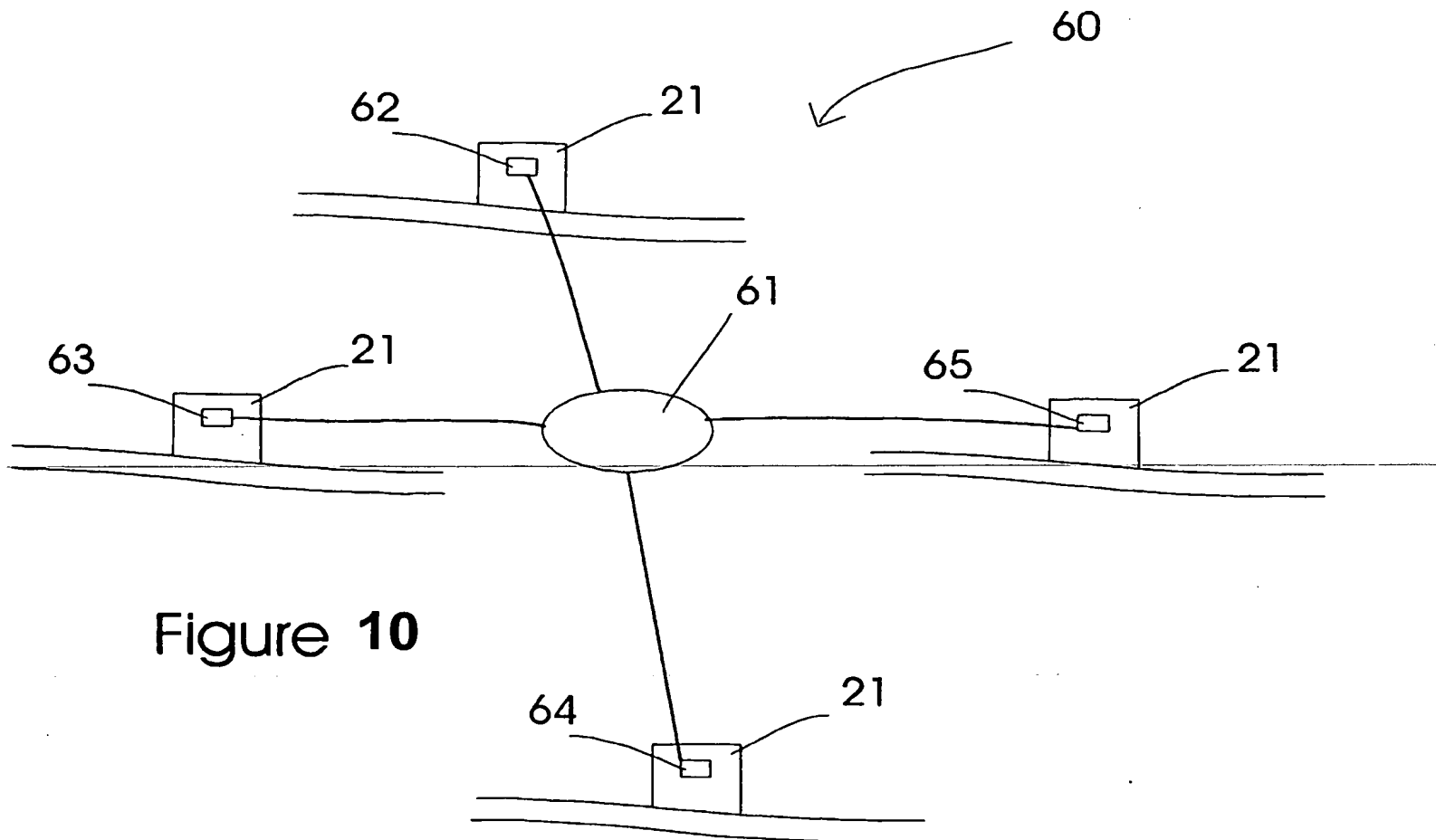


Figure 10

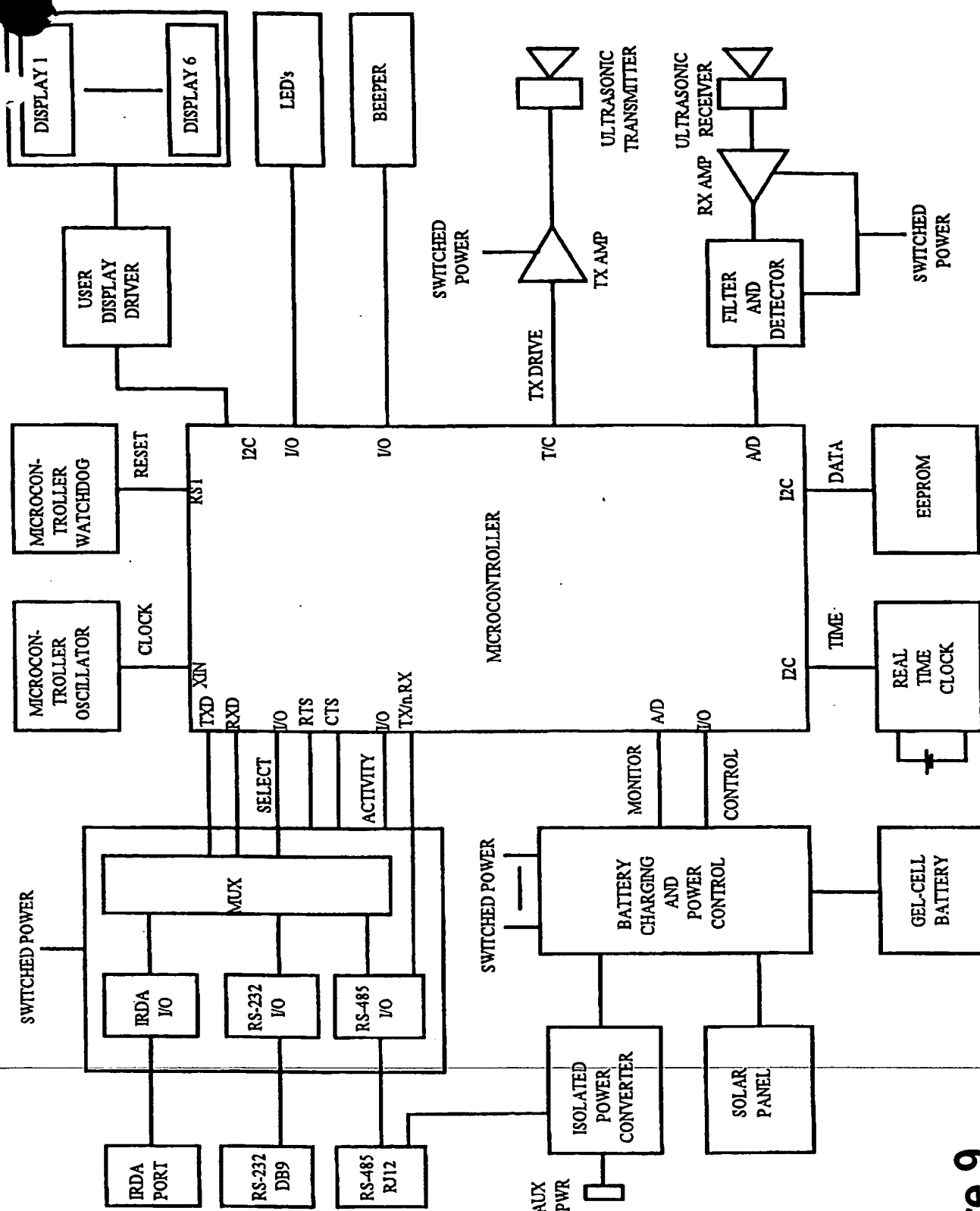


Figure 9